

750 Randall (B. Alex) *W. M. D. Taylor*  
60 *with the initials complete*

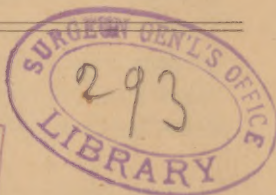
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A STUDY  
OF  
THE EYES OF MEDICAL STUDENTS.

BY  
B. ALEX. RANDALL, A.M., M.D.,  
OPHTHALMIC AND AURAL SURGEON TO THE EPISCOPAL AND CHILDREN'S HOSPITALS, PHILADELPHIA.

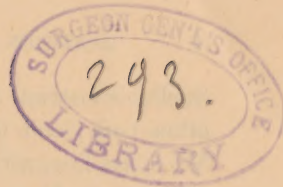
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DUPLICATE.  
College of Physicians,  
OF PHILADELPHIA.



SOLD.





# A STUDY OF THE EYES OF MEDICAL STUDENTS.

BY B. ALEX. RANDALL, A. M., M. D.,  
OF PHILADELPHIA.

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In giving a course of demonstrations of the Physiology of Vision, last Autumn, in the Physiological Laboratory of the University of Pennsylvania, the writer endeavored to furnish a practical application of the methods of study brought forward, by instituting an examination of the eyes of each of the students composing the class. The determinations were carefully made and the results systematically recorded upon schemes prepared for the purpose; and as now given, their accuracy in almost every point can be vouched for. As the examination was a means, however, and not an end, the same care could not be given to secure its completeness; and of about 120 students examined, records are at hand as to the refraction of but 90. As the study could not always be finished upon the same day that it was begun, some of the examinations remain incomplete; while not a few of the records have been mislaid, as they were unwisely entrusted in the interval to the individuals concerned. Since we have data, however, as to the refraction of 90 of the 135 students in this second-year class, it has seemed on some grounds worth while to put even this small number upon record; especially when Prof. Cohn, after making examinations embracing many thousands of individuals, has thought the results of his study of the eyes of 108 medical students worth recording.

As to the details of the examinations some remarks seem in place. Each eye was, of course, separately tested, although some binocular tests were also made. The vision was determined in good daylight, in the laboratory, at a distance of 6 metres—the positions of test-card and individual being shifted, when necessary, so as to secure at the different times the most uniform illumination.

Snellen's metrical card or that of the writer was the test employed—often both; and the easy recognition of *all* of the letters of the VI metre line, with the easier ones of the line below, was demanded to constitute  $V = \frac{6}{VI}$ —any hesitation or uncertainty being noted. The accommodation was tested with No. 1 of Jaeger's type, and the near-point noted was always (unless in a few cases not tested under the writer's own eye) that of the nearest *perfectly sharp* vision—a noteworthy point, since type of this size can be *read* easily when considerably blurred. The fine *dot-tests* of Burchardt were occasionally used as control-tests. Subjective recognition of astigmatism was sought by revolving the narrow parallel band of Green's series. The test for manifest refraction was begun with very weak glasses ( $= 0.25$  D.), and carried on to that glass which gave the best visual result, or that convex glass through which the best visual result was still attainable. The muscular relations were studied by noting the movements of the eyes by alternate covering with a card—the fixation object being *never* the finger, but a fine point demanding accurate accommodation to see it clearly at the 30 c.m. distance employed. This method has been employed by the writer for about five years, and can be unhesitatingly recommended as giving in careful hands results as accurate as to the *presence* and *degree* of insufficiency of the interni or externi as the test of v. Graefe. As, however, a certain amount of repetition of any test is needed to uncover the full amount of insufficiency of the interni, which time did not in this case permit, the figures given are almost always somewhat of an underestimate of the degree, as was often shown when the Graefe-test was employed later. In making the latter test a very fine "dot-and-line" was used, and the measurement made with a  $6^\circ$  prism vertical and the revolving prism of Herschel (Cretès). In the ophthalmoscopic investigation the improvised dark-room was not always fully satisfactory, and a few contradictory results were obtained, some of which could be cleared up only in the dark-room of the eye-clinic. The examinations were all made by the writer himself (sometimes with the confirmation of other ophthalmoscopists of skill), with the instrument of Loring. The refraction was measured at a point about midway between the optic disk and the macula, looking through the inner part of the corneal reflex, *i. e.*, almost exactly in the axis of the eye. The examiner's  $H = 0.75$  D., which has been accurately measured under mydriatics by Dr. Risley, was

always allowed for or corrected by his glass; (hence the rather frequent occurrence of  $H = 0.75$  in the records, which means that the finest details of the fundus near the macula were sharply seen with  $+ 1.5$  D.). Retinoscopy with the plane mirror from a distance of 2-3 metres was also often employed as a controlling test. Further, when the individuals had been corrected previously under a mydriatic, the result was ascertained and noted; as also in case of some who were so examined at a shortly subsequent time.

That *independence* of the various details of the examination, which has been made much of by some examiners, was neither desired nor sought. To work thus in the dark is doubtless well for those who cannot trust themselves to obtain unbiased results, if they are aware of conflicting findings. Whenever possible, all the other data were before the examiner as he made the ophthalmoscopic measurement, and he permitted himself neither to force his reading of the refraction into accord with other findings, nor to be shamed out of noting his failures to obtain with this means the results which were evidently the correct ones. The newer ophthalmoscope of Loring is probably the most perfect instrument in existence for the measurement of the refraction; and more than five years' incessant use of it under all circumstances has given the writer a confidence in its readings that work with atropinized eyes and the artificial eye does not show to be overweening. Yet any concealment of its fallibility would be utterly unjust, and would tend to weaken the fair claim that this method is the one which, in the absence of complete paralysis of the accommodation, will most frequently approximate accuracy. Since no single test can be entirely relied on, however, so here the ophthalmoscopic reading must often be revised in the light of the other data, in order to obtain the aim of this investigation—the true refraction of the eye.

No.	NAME.	Degree.	Ag. Fr.	VISION.	MANIFEST R.	OPHTHALMOSC. R.	MYDRIATIC R.	P. p.	P. r.	Lines at	FUNDUS.	Insuf.
1	H. W. A.	...	19	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} + \\ \text{O.S. } \frac{1}{8} + \end{array} \right\}$	..... Em.	..... Em.	.....	14. 12.	55. 60.	...	..... .....	4°
2	J. W. B.	...	19	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} ? \\ \text{O.S. } \frac{1}{8} ? \end{array} \right\}$	Em. -25%	+1.5 (V.V., H.v. +1.) Em.	.....	9. 10.	68. 65.	90° 90°	..... Conus out. Conus out.	0°
3	J. G. C.	...	19	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} ? \\ \text{O.S. } \frac{1}{8} ? \end{array} \right\}$	-25% -9%	Em? (-25%) +75 (V.V.)	.....	8. 7.	62. 55.	180° 45°	..... .....	0°
4	D. T. L.	...	19	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} ? \\ \text{O.S. } \frac{1}{8} ? \end{array} \right\}$	Em. Em.	+75 (V.V.) +75 (V.V.)	.....	11. ...	...	45°	.....	?
5	J. G. S.	...	19	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} + \\ \text{O.S. } \frac{1}{8} + \end{array} \right\}$	.....	+75 +75	.....	12. 14.	70. 75.	45° ...	..... .....	3°
6	W. S. S.	B.A.	19	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} \\ \text{O.S. } \frac{1}{8} \end{array} \right\}$	Em. -2.	Em. -1.5	.....	11. 8.	45. 40.	...	.....	?
7	W. H. T.	...	19	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} \\ \text{O.S. } \frac{1}{8} \end{array} \right\}$	+5 +5	+2 (V.V., H.v. +1.?) +2 (V.V., H.v. +1.?)	.....	10. 10.	47. 43.	...	.....	0°
8	E. M.	B.A.	19	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} \\ \text{O.S. } \frac{1}{8} \end{array} \right\}$	+5 +5	+1.25 (V.V.) +1.25 (V.V.)	.....	10. 10.	40. 40.	...	..... Conus. Conus.	...
9	E. T. W.	B.A.	19	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} + \\ \text{O.S. } \frac{1}{8} + \end{array} \right\}$	.....	+75 (V.V.) +5? (V.V.)	.....	13. 12.	53. 52.	180°? 180°?	.....	4°
10	W. C. A.	...	20	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} \\ \text{O.S. } \frac{1}{8} \end{array} \right\}$	Em. (+5?) +5 3/4	Em. (+5?) +5 (As?)	.....	9. 8.	65. 65.	...	Conus in and out. Conus in and out.	0°
11	J. N. B.	...	20	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} ? \\ \text{O.S. } \frac{1}{8} ? \end{array} \right\}$	.....	+1.25 +1.25	.....	12. 11.	80. 90.	90° 90°	..... .....	5°
12	G. H. C.	...	20	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} \\ \text{O.S. } \frac{1}{8} \end{array} \right\}$	-75 -75	Em? (-5?) Em? (-5?)	.....	11. 11.	45. 45.	165° 165°	Conus out. Conus out.	4°
13	W. A. N. D.	B.A.	20	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} ? \\ \text{O.S. } \frac{1}{8} ? \end{array} \right\}$	Em. -5 (?)	+5 +5	.....	...	...	120° 75°	Conus, had Choroid. Slight Conus.	5°
14	C. W. C.	...	20	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} \\ \text{O.S. } \frac{1}{8} \end{array} \right\}$	.....	Em. +5	.....	9. 8.	36. 37.	90° 90°	Conus. .....	?
15	J. L. H.	...	20	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} ? \\ \text{O.S. } \frac{1}{8} ? \end{array} \right\}$	+75 +75	+75 +1.25 (V.V.)	+75 +75	13. 13.	50. 52.	75° 105°	..... .....	0°
16	K. C. J.	...	20	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} ? \\ \text{O.S. } \frac{1}{8} ? \end{array} \right\}$	-5 -5 (?)	+5 -5	.....	22. 24.	47. 42.	? ?	Slight Conus. Slight Conus.	5°
17	J. W. L.	...	20	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{8} \\ \text{O.S. } \frac{1}{8} \end{array} \right\}$	Em?	-5 Em?	.....	10. 11.	45. 20.	10° 170°	Slight Conus, Choroid disturb. Slight Conus.	0°

No.	NAME.	Degree.	VISION.	MANIFEST R.	OPHTHALMOSC. R.	MYDRIATIC R.	P. p.	P. r.	Lines at	FUNDUS.	Insuf.
18	R. L.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	-5 Em.	+5 Em.	.....	13. 12.	49. 61.	$\left\{ \begin{array}{l} 120^{\circ} \\ 60^{\circ} \end{array} \right\}$	..... .....	3°
19	W. E. S.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	-5? Em.	Em.	.....	11. 10.	44. 49.	...	Sl. Conus. Sl. Conus.	5°
20	T. L. S.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	+5 $\frac{2}{3}$ + +65 $\frac{2}{3}$ +	+1.5 (V.V., H.v. +1.) +1.5 (V.V., H.v. +1.)	.....	13. 20.	45. 90°	105°	Slight Conus. Choroido-retinal disturb.	5°G.
21	W. C. McC.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	.....	+75 +1.	.....	11. 10.	55. 75°	90° 75°	..... .....	0°
22	J. W.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	.....	+5 (V. at 60°) +75 (V.V.)	.....	...	...	180° ?	Retina striated and vess. tortuous.	3°
23	W. W. W.	B. A.	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	+5 Em.	+5 +5	.....	12. 12.	60. 60.	...	Conus, atrophic. Sl. Conus.	3°
24	W. Z.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	+65 +75	+1.5? +1. +	.....	9. 45.	45. 45.	...	Conus, Choroid bad.	0°
25	G. F. B.	B. S.	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	-1. -5	-5 Em.	.....	9.5 10.5	45. 45.	40°	Conus. Conus.	6°
26	T. D.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	-25 Em.	-5? +5 (V.V.)	.....	13. 11.	32. 35.	90°	..... .....	0°
27	E. W. J.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	.....	+1. +1.	.....	12. 11.	55. 55.	60° 120°	..... .....	?
28	I. L.	B. S.	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	-5 -5	+1.5 (H.v. +1.) +1.5 (H.v. +1.)	.....	10. 10.	42. 50.	90 10	..... .....	0°
29	S. G. T. M.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	.....	Em? Em?	.....	11. 10.	...	...	Conus, atrophic. Conus, atrophic.	0°
30	J. R. McC.	Phar. G.	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	Em.	+1. (H.v. +5) +1. (H.v. +5)	.....	13. 14.	55. 55.	...	Slight Conus. Slight Conus.	6°
31	E. T. N.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	Em.	+5 (V.V.) +5 (V.V.)	.....	13. 37.	37. 30°	...	Conus. Conus.	4°
32	O. E. S.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	Em?	+5 (V.V., higher)	.....	11. 10.	52. 52.	...	Sl. Conus. Sl. Conus.	0°
33	A. J. S.	B. A.	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	.....	+5 +5 (H.v. V.V. higher)	.....	8. 10.	70. 43.	90° 120°	..... .....	...
34	E. K. W.	...	$\left\{ \begin{array}{l} \text{O.D. } \frac{2}{3} \\ \text{O.S. } \frac{2}{3} \end{array} \right\}$	+65 $\frac{2}{3}$ + +75 $\frac{2}{3}$ +	+75 +75	.....	10. 10.	65. 60.	150° 150°	Sl. Pigment Conus. Sl. Pigment Conus.	5°(6°G.)

No.	NAME.	Degree.	AGE.	VISION.	MANIFEST R.	OPHTHALMOSC. R.	MYDIATIC R.	P. p.	P. r.	Lines at	FUNDUS.	Insuf.
35	W. H. B.	...	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\} ?$	$\begin{array}{l} -.5 \\ +.5 \end{array}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 16. \\ 17. \end{array}$	$\begin{array}{l} 53. \\ 55. \end{array}$	...	Semi-troph. Conus, down and out.	2°
36	W. H. Br.	B. Phil.	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\} ?$	$\begin{array}{l} -.5 \\ \text{Em.} \end{array}$	$\begin{array}{l} +.1? \\ +.75 \end{array}$	$\begin{array}{l} \text{.....} \\ +.75 \end{array}$	11.	...	90°	SI. Conus.	2°
37	W. A. C.	...	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\} ?$	$\begin{array}{l} +.75 \\ +.75 \end{array}$	$\begin{array}{l} +.2? \text{ (V.V., H.v. + 1.)} \\ +.2? \text{ (V.V., H.v. + 1.)} \end{array}$	$\begin{array}{l} +.75 \text{ C} +.5 \text{ c. ax. } 70^\circ \\ +.9 \text{ C} +.9 \text{ c. ax. } 90^\circ \end{array}$	$\begin{array}{l} 11. \\ 10. \end{array}$	$\begin{array}{l} 44. \\ 44. \end{array}$	180°	SI. Conus.	3°
38	J. C. C.	...	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \text{ diff.} \\ \text{O.S. } \frac{1}{2} \text{ diff.} \end{array} \right\}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 10. \\ 12. \end{array}$	$\begin{array}{l} 55. \\ 55. \end{array}$	180°?	Choroid woolly.	0°
39	E. M. G.	B. A.	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \text{ diff.} \\ \text{O.S. } \frac{1}{2} \text{ diff.} \end{array} \right\}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} +.5? \text{ (V.V.)} \\ +.5 \text{ (V.V.)} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 12. \\ 14. \end{array}$	$\begin{array}{l} 55. \\ 48. \end{array}$	?	Conus out. Choroid woolly.	8°
40	L. J. H.	...	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\} ?$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} +.5 \\ +.5 \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 14. \\ 14. \end{array}$	$\begin{array}{l} 48. \\ 48. \end{array}$	135°	Conus.	7°
41	J. H. H.	...	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} +.5 \\ +.5 \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 15. \\ 15. \end{array}$	$\begin{array}{l} 45. \\ 50. \end{array}$	30°	Choroid disturbed throughout.	0°
42	E. J. M.	B. A.	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 15. \\ 15. \end{array}$	$\begin{array}{l} 50. \\ 50. \end{array}$	150°	Conus out.	0°
43	P. J. S.	B. A.	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} +.5 \\ +.5 \end{array}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 15. \\ 15. \end{array}$	$\begin{array}{l} 50. \\ 50. \end{array}$	...	Conus (pigment).	0°
44	A. N. T.	...	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} +.75 \\ +.15 \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 13. \\ 12. \end{array}$	$\begin{array}{l} 50. \\ 53. \end{array}$	13°	Conus (pigment) out and in.	4°
45	T. S. W.	B. A.	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} -.5 \\ -.5 \end{array}$	$\begin{array}{l} +.15 \\ -.45 \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 10.5 \\ 11. \end{array}$	$\begin{array}{l} 53. \\ 105^\circ \end{array}$	...	Conus in each.	0°
46	U. W.	B. A.	22	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} -.65 \\ -.75 \end{array}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 6. \\ 23. \end{array}$	$\begin{array}{l} 23. \\ 26. \end{array}$	150°	Choroid in bad condition, and Conus in each.	10°
47	F. A. A.	...	23	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} -1.25 \\ -1.25 \end{array}$	$\begin{array}{l} -.5 \\ -.5 \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 9. \\ 45. \end{array}$	$\begin{array}{l} 45. \\ 105^\circ \end{array}$	75°	Conus.	Conv.
48	C. W. B.	B. S.	23	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} -1.0 \\ -1.0 \end{array}$	$\begin{array}{l} +.1 \text{ (V. at } 50^\circ \text{ at } 140^\circ \text{ M?)} \\ +.1.25 \text{ (V. at } 120^\circ) \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 9. \\ 48. \end{array}$	$\begin{array}{l} 48. \\ 60^\circ \end{array}$	120°	Conus. Choroid woolly.	0°
49	E. W. C.	...	23	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} +.75 \\ +.75 \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 12. \\ 32. \end{array}$	$\begin{array}{l} 32. \\ 60^\circ \end{array}$	60°	Conus. Choroido-Ret. disturbance.	0°
50	S. P. C.	B. A.	23	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} +.65 \\ +.65 \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 14. \\ 23.5 \end{array}$	$\begin{array}{l} 23.5 \\ 165^\circ \end{array}$	165°	Slight Conus.	0°
51	W. D. G.	B. A.	23	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} \text{Em.} \\ \text{Em.} \end{array}$	$\begin{array}{l} +.75 \text{ (V.V., H.v. + 5)} \\ -2.5 \text{ (V.V., H.v. - 3)} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 10. \\ 75. \end{array}$	$\begin{array}{l} 81. \\ 75. \end{array}$	...	Slight Conus.	0°
52	H. H. K.	B. A.	23	$\left\{ \begin{array}{l} \text{O.D. } \frac{1}{2} \\ \text{O.S. } \frac{1}{2} \end{array} \right\}$	$\begin{array}{l} -2.75 \\ -2.75 \end{array}$	$\begin{array}{l} -2.5 \text{ (V.V., H.v. - 3)} \\ -2.5 \text{ (V.V., H.v. - 3)} \end{array}$	$\begin{array}{l} \text{.....} \\ \text{.....} \end{array}$	$\begin{array}{l} 12. \\ 30. \end{array}$	$\begin{array}{l} 30. \\ 37. \end{array}$	90°	Conus } Choroido-Ret. disturbance.	5°

No.	NAME.	Degree.	Age.	VISION.	MANIFEST R.	OPHTHALMOSC. R.	MYDIATIC R.	P. p.	P. r.	Lines at	FUNDUS.	Insuf.
53	W. P. L.	...	23	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	+ .65 Em.	+ .75 ? + .5	.....	15. 13.	53. 66.	105° 75°	Ret. vess. tortuous. Conus.	?
54	C. E. M.	...	23	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	Em. Em.	+ .75 (V.V.) + 1. (V.V., H.v. + .75)	.....	10. 12.	38. 38.	90° 90°	Conus. Conus.	3°
55	H. B. M.	G. Phar.	23	{ O.D. $\frac{7}{16}$ } { O.S. $\frac{7}{16}$ } + .5	Em. Em.	+ 1. (V.V.) + .5 (V.V.)	+ .75 C. ax. 90° + 25 C. ax. 90°	10. 10.	84. 80.	90° 75°	Choroid in bad condition.	5° (8° G.)
56	J. M.	...	23	{ O.D. $\frac{6}{16}$ } { O.S. $\frac{6}{16}$ } + .5	Em. Em.	+ .5 (V.V.) + .5 (V.V.)	.....	10. 11.	51. 54.	180°? 90°?	.....	?
57	E. E. P.	...	23	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	Em. Em.	+ .75 (V.V.) + .75 (V.V.)	.....	10. 10.	60. 60.	180° 165°	Slight Conus } Choroid disturbed. Slight Conus }	...
58	T. G. L.	...	23	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	Em. Em.	+ .75 (V.V.) + .75 (V.V.)	.....	13. 13.	65. 65.	... ...	Slight Conus. Slight Conus.	...
59	F. D.	...	24	{ O.D. $\frac{7}{16}$ } { O.S. $\frac{7}{16}$ }	- 1. $\frac{8}{16}$ - .5	Em. Em.	.....	15. 14.	42. 43.	10°? 90°?	Conus.	?
60	C. J. H.	...	24	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	Em. - .5?	+ .5 (V.V., H.v. M.?) - 1. (V.V., H.v. - 1.5)	.....	13. 13.	75. 75.	180° 180°	Slight Conus } Choroid in bad condition. Slight Conus }	3° G.
61	J. H. H.	...	24	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	- .5 - .5	+ .5 (V.V.) + .5 (V.V.)	.....	10. 10.	... ...	40° 180°	Conus. Conus.	?
62	J. H. K.	B. A.	24	{ O.D. $\frac{7}{16}$ } { O.S. $\frac{7}{16}$ }	+ .5 + .5	+ .75 (V. at 75°) + .5 (V.V.)	.....	11. 8.	28. 37.	... ...	Conus. Conus.	3°
63	A. M. L.	...	24	{ O.D. $\frac{4}{16}$ } { O.S. $\frac{4}{16}$ }	..... .....	+ .75 + .75	.....	7.5 (7.5)	60. 60.	180° 180°	.....	...
64	G. A. L.	B. A.	24	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	Em. + .5	+ .5 + (V. at 60°) + .5 + (V. at 120°)	.....	18. 20.	44. 43.	135° 135°	Pigment Conus. Pigment Conus.	(Conv.)
65	T. S. R.	...	24	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	Em. Em.	+ .5 ? + .5	.....	6.5? 9.	53. 54.	75° 100°	Slight Conus. Slight Conus.	(Conv.)
66	A. V. S.	B. A.	24	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	Em. Em.	+ .5 + + .5	.....	14. 12.	55. 56.	... ...	Slight Conus out. Slight Conus.	0° (G.)
67	J. B. T.	...	24	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	+ .5 + .5	+ .75 + + .75 +	+ 9 + 9	15. 16.	60. 65.	180° 180°	Conus out and in. Conus out.	5° (12° G.)
68	W. S. W.	...	24	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	Em (- .5 ?) Em (- .5 ?)	+ .75 (V.V., H.v. + .5) + 1.5 (V.V., H.v. + .75)	.....	12. 13.	40. 40.	... ...	Slight Conus out. Slight Conus out.	2° (1° G.)
69	S. T. W.	B. A.	?	{ O.D. $\frac{8}{16}$ } { O.S. $\frac{8}{16}$ }	+ .65 + .65	+ .75 + .1	.....	12. 12.	60. 60.	90° 90°	.....	...

No.	NAME.	Degree.	Age	VISION.	MANIFEST R.	OPHTHALMOSC. R.	MYDIATIC R.	P. p.	P. r.	Lines at	FUNDUS.	Insuf.
70	W. J. H.	B. A.	?	$\left\{ \begin{array}{l} \text{O.D.} \\ \text{O.S.} \end{array} \right\}$	.....	$\left\{ \begin{array}{l} +.75 \text{ (V.V.)} \\ +.75 \text{ (V.V.)} \end{array} \right\}$	.....	...	...	...	.....	3°
71	P. Y.	...	?	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{16} \\ \text{O.S.} \frac{5}{16} \end{array} \right\}$	-5.	-5.	.....	8.	27.	...	.....	5°
72	L. M.	B. S.	?	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{16} \\ \text{O.S.} \frac{5}{16} \end{array} \right\}$	.....	$\left\{ \begin{array}{l} +1. \text{ (V.V.)} \\ +1.5 \text{ (V.V.)} \end{array} \right\}$	.....	15.	28.	...	.....	...
73	J. R. C.	...	25	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{16} \\ \text{O.S.} \frac{5}{16} \end{array} \right\} +$	-5 $\frac{5}{8}$ ?	$\left\{ \begin{array}{l} +.5 \text{ (V.V. + 1.)} \\ +.5 \text{ (V.V. + 1.)} \end{array} \right\}$	.....	12.5	39.	90°?	Slight Conus.	10°G.
74	R. F. B. M.	B. A.	25	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{8} \\ \text{O.S.} \frac{5}{8} \end{array} \right\}$	-5	$\left\{ \begin{array}{l} +.5 \\ \text{Em.} \end{array} \right\}$	.....	13.	48.	120°	Slight Conus.	?
75	J. H. O.	B. A.	25	$\left\{ \begin{array}{l} \text{O.D.} \frac{1}{16} \\ \text{O.S.} \frac{1}{16} \end{array} \right\}$	?	$\left\{ \begin{array}{l} -9 \text{ (H.V.)} \\ +1.25? \text{ (V.V., H.V. + 5)} \end{array} \right\}$	-9 c. ax. 180° +75 c. ax. 105°	10.	20.	90°	Underlying Conus down.	5°
76	A. S.	B. A.	25	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{8} \\ \text{O.S.} \frac{5}{8} \end{array} \right\}$	+5	$\left\{ \begin{array}{l} +.75 \\ +.75 \text{ (H.V., V.V. + 5)} \end{array} \right\}$	.....	14.	54.	90°	Underlying Conus down.	0°
77	L. I. S.	B. A.	25	$\left\{ \begin{array}{l} \text{O.D.} \frac{7}{16} \\ \text{O.S.} \frac{7}{16} \end{array} \right\}$	-5 $\frac{8}{8}$	$\left\{ \begin{array}{l} +.75 \\ +1. \text{ (H.V., V.V. + 5)} \end{array} \right\}$	.....	10.	65.	...	Conus } { Large, atrophic and with aberrant vess.	3°
78	S. W. B.	...	26	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{8} \\ \text{O.S.} \frac{5}{8} \end{array} \right\}$	-5	$\left\{ \begin{array}{l} \text{Em.} \\ \text{Em.} \end{array} \right\}$	.....	10.	57.	75°	.....	0°
79	C. E. E.	...	26	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{8} \\ \text{O.S.} \frac{5}{8} \end{array} \right\}$	-5	$\left\{ \begin{array}{l} +.5? \\ \text{Em.} \end{array} \right\}$	.....	10.	60.	105°	.....	?
80	G. M. M.	B. A.	26	$\left\{ \begin{array}{l} \text{O.D.} \\ \text{O.S.} \end{array} \right\}$	.....	$\left\{ \begin{array}{l} +1.25 \text{ (V. at 75°)} \\ +.5 \text{ (V.V.)} \end{array} \right\}$	.....	18.	52.	...	Conus.	5°
81	J. H. K.	...	27	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{16} \\ \text{O.S.} \frac{5}{16} \end{array} \right\}$	-75	$\left\{ \begin{array}{l} +.5 \text{ (V.V., H.V. + 1)} \\ +2. \text{ (V.V., H.V. + 75)} \end{array} \right\}$	+65 C + 1.5 c. ax. 90° +75 C + 1.5 c. ax. 90°	10.	57.	180°	Conus, out and in.	0°
82	W. L. M.	...	27	$\left\{ \begin{array}{l} \text{O.D.} \\ \text{O.S.} \end{array} \right\}$	+5	$\left\{ \begin{array}{l} +.75 \\ +.75 \end{array} \right\}$	.....	11.	53.	150°	Slight Conus.	...
83	A. T. W.	...	27	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{16} \\ \text{O.S.} \frac{5}{16} \end{array} \right\}$	-9	$\left\{ \begin{array}{l} +.75 \\ +.75 \end{array} \right\}$	.....	13.	30.	180°	Slight Conus.	...
84	C. B. McG.	...	28	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{16} \\ \text{O.S.} \frac{5}{16} \end{array} \right\}$	+65 $\frac{8}{8}$	$\left\{ \begin{array}{l} -1.5? \\ +.5 \end{array} \right\}$	.....	12.	25.	180°	Large Conus.	0°
85	H. E. F.	...	29	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{16} \text{ dif.} \\ \text{O.S.} \frac{5}{16} \text{ dif.} \end{array} \right\}$	.....	$\left\{ \begin{array}{l} \text{Em.} \\ +.5 \text{ (V.V.)} \end{array} \right\}$	.....	13.	60.	15°	.....	...
86	F. G. H.	B. A.	29	$\left\{ \begin{array}{l} \text{O.D.} \frac{5}{16} \\ \text{O.S.} \frac{5}{16} \end{array} \right\}$	+5	$\left\{ \begin{array}{l} +.1 \\ +1.5 \end{array} \right\}$	+1.5 +1.5	11.5	35.	165°	Conus.	3°
					-5 $\frac{1}{16}$			10.5	51.	...	Conus.	0°
								13.	37.	150°?	Underlying Conus out.	5° (3°G.)
								11.	35.	120°	Conus below. Chor. disturb.	...
								13.	38.	105°	Conus.	...
								14.	41.	75°	Conus.	...
								11.5	...	...	Conus out, underlying Conus down.	0°
								12.5	...	15°	Slight Conus, down and out.	...

No.	NAME.	Degree.	AGE.	VISION.	MANIFEST R.	OPHTHALMOSC. R.	MYDIATIC R.	P. p.	P. r.	Lines at	FUNDUS.	Insuf.
87	D. A.	Phar. G.	30	$\left\{ \begin{array}{l} \text{O.D. } \frac{6}{8}, \frac{7}{8} \\ \text{O.S. } \frac{7}{8}, \frac{9}{10} \end{array} \right.$	$\left\{ \begin{array}{l} -.5 \\ -.5 \end{array} \right.$	$\left\{ \begin{array}{l} +.5 \\ +.75 \end{array} \right.$	.....	17.	$\left\{ \begin{array}{l} 50. \\ 50. \end{array} \right.$	$\left\{ \begin{array}{l} 90^{\circ} \\ 180^{\circ} \end{array} \right.$	Retinal disturbance.	$\left\{ \begin{array}{l} 0\frac{1}{2} \text{ S.G.} \\ 4^{\circ} \end{array} \right.$
88	L. M. H.	...	30	$\left\{ \begin{array}{l} \text{O.D. } \frac{6}{8} \\ \text{O.S. } \frac{6}{8} \end{array} \right.$	$\left\{ \begin{array}{l} -.5? \\ -.5? \end{array} \right.$	Em.	.....	14.	49.	...	.....	$\left\{ \begin{array}{l} 4^{\circ} \\ 4^{\circ} \end{array} \right.$
89	E. J. K.	...	30	$\left\{ \begin{array}{l} \text{O.D. } \frac{6}{8} \\ \text{O.S. } \frac{6}{8} \end{array} \right.$	Em.	$\left\{ \begin{array}{l} +.5 \\ \text{Em.} \end{array} \right.$	.....	10.	65.	...	Slight Conus.	$\left\{ \begin{array}{l} 4^{\circ} \\ 4^{\circ} \end{array} \right.$
90	J. V. F.	...	31	$\left\{ \begin{array}{l} \text{O.D. } \frac{6}{8} \\ \text{O.S. } \frac{6}{8} \end{array} \right.$	.....	$\left\{ \begin{array}{l} +.5 \text{ (V.V.)} \\ \text{Em.} \end{array} \right.$	.....	15.	51.	90°	Conus.	...
91	E. T.	B. A.	32	$\left\{ \begin{array}{l} \text{O.D. } \frac{6}{8} \\ \text{O.S. } \frac{6}{8} \end{array} \right.$	$\left\{ \begin{array}{l} -.75 \frac{6}{8} \\ -.5? \end{array} \right.$	.....	.....	11.	60.	130°	Conus.	$\left\{ \begin{array}{l} 7^{\circ} \\ 7^{\circ} \end{array} \right.$
92	S. G. D.	...	33	$\left\{ \begin{array}{l} \text{O.D. } \frac{16}{20} + \\ \text{O.S. } \frac{16}{20} + \end{array} \right.$	$\left\{ \begin{array}{l} -.75 \frac{16}{20} \\ \text{Em.} \end{array} \right.$	$\left\{ \begin{array}{l} -.5? \\ +.5 \end{array} \right.$	.....	18.	45.	15°	.....	$\left\{ \begin{array}{l} 7^{\circ} \\ 7^{\circ} \end{array} \right.$
							.....	17.	50.	45°	Slight Conus.	$\left\{ \begin{array}{l} 7^{\circ} \\ 7^{\circ} \end{array} \right.$

Summarizing the above results, we find in the column of ophthalmoscopic refraction :—

90 individuals. Em. 11 = 12.2%; Em. and M. 4 = 4.4%; M. 6 = 6.6%; M. and H. 3 = 3.3%; H. 55 = 61.1%; H. and Em. 11 = 12.2%.  
 180 eyes. Em. 37 = 20.5%; M. 21 = 11.6%; H. 122 = 67.7%; (Astigmatic: H. 64 = 35.5%; M. 5 = 2.8%).

In 6 cases, however (aside from minor variations of 0.25 or less, in the degree of ametropia), the ophthalmoscopic measurement cannot be accepted as correct (Nos. 26, 29, 35, 43, 59 and 83), and making the necessary corrections, we find :—

180 eyes. Em. 32 = 18.8%; M. 17 = 9.5%; H. 131 = 72.8%.

Comparing, now, the results as to the frequency and the degree of refraction-error, as found by the ophthalmoscope, and by the subjective measurement, we obtain the following:—

Age. Eyes.	Em. + 0.5	-.65	.75	.1 + 1.25 + 1.5	2. H.	Av. H.	0.25	-.5	-.65	-.75	-.9	-.1	1.25	1.5	1.75	2.	2.75	3.	4.5	5.	M.	Av. M.	
19-20 {	(Manifest	11	7	2	3	...	12	0.59	1	6	...	2	1	...	...	...	1	...	...	...	11	0.59	
34 {	(Opthalm.	11	8	...	3	2	4	2	0.97	...	1	...	...	...	1	...	...	...	...	...	2	1.9	
21-22 {	(Manifest	13	3	1	3	...	...	7	0.63	1	5	1	...	...	...	...	...	...	1	1	10	1.39	
30 {	(Opthalm.	10	5	...	3	3	...	2	0.98	...	2	...	1	...	...	...	...	...	2	...	5	2.59	
23-24 {	(Manifest	21	7	3	...	...	...	10	0.54	...	4	...	1	1	1	...	2	1	...	1	13	1.57	
44 {	(Opthalm.	3	16	2	10	4	1	1	0.69	...	1	...	...	...	2	...	...	...	3	...	7	2.28	
24 {	(Manifest	6	6	2	...	...	...	8	0.54	...	13	...	5	1	1	...	...	...	...	...	20	0.61	
34 {	(Opthalm.	7	8	...	5	5	1	1	0.88	...	3	...	...	1	...	...	...	...	...	...	5	0.78	
Total 142 {	(Manifest	31	23	8	6	...	...	37	0.57	2	28	1	8	2	3	1	1	2	1	1	2	54	1.03
142 {	(Opthalm.	31	37	2	21	14	4	8	0.85	...	7	...	...	2	...	4	...	...	3	2	1	19	1.89
Total 150 in all ....		32	56	2	34	18	6	10	0.82	...	7	...	...	2	...	2	...	2	1	2	1	15	1.89

The degree of ametropia given is that of the most ametropic meridian.

The cases where the refraction, as determined under a mydriatic, is known are, unfortunately, too few to need any summarizing. Case No. 45 was measured under atropine, and cases 55 and 86, by the writer, under hyoscyamine, shortly after the other examination; the others had been previously tested, generally at the University clinic, under atropine.

Study of the range of accommodation shows the results to accord well with the figures of Donders. Of 174 eyes tested, but 20 had more than 11 D. of accommodation, and only 26 less than 7.5 D. (the refraction being always taken into account). Several of the high results are of questionable accuracy: most of the low figures are to be ascribed to astigmatism. The average range among those 19 years of age was  $A.=10.5$ ; among the oldest men (28-33 years),  $A.=7.8$  D.: among all examined,  $A.=9.17$  D.

The astigmatic lines were selected with more or less definiteness by 173 eyes as best seen in some one direction. Of these, 54 seemed astigmatic by other tests, while 15, which did not select lines, appeared to be none the less really astigmatic. This anomaly is therefore noted in 69 cases, exclusive of doubtful ones, as present in measurable degree (0.5 D. or more). Insufficiency of the convergence for the near (30 cm.) was recorded in 42 cases, the estimated degree varying from  $2^{\circ}$  to  $12^{\circ}$ . In ten individuals it was hardly measurable ("?"), in 26 it seemed absent, while in 9 data are lacking. The ophthalmoscope showed a large amount of intra-ocular trouble, generally of no high grade; yet more marked than could be set down as the retinal striation, etc., due to hard work—*i. e.* the typical "student's eye-ground," by which tradition says some German "savants" gauge the diligence of their pupils. Notable absorption of pigment at the nerve-entrance, comprising all forms of so-called "conus," was found in 116 eyes. Where the pigment in the choroid ring was dense, and the irregularity of its distribution was apparently, yet not certainly, due to pathological absorption, the condition was set down as "pigment conus." Narrow crescents, whether semi-atrophic or atrophic, are generally noted as "slight," until the breadth of the retinal vein is exceeded. When more than one-fourth of the diameter of the disk, they are termed "large." In 17 cases the disturbed condition of the choroid is noted, the condition being sufficiently marked to call for treatment without delay: in several others the tortuosity of the retinal vessels and the blurring of the nerve margins prompted to a careful

search for extravasations or splotches, and the eyes had to be looked upon as diseased and demanding medical care. Of the few approximately healthy eye-grounds, almost all were in students who had been under treatment at the clinic, or who seemed, by all tests, emmetropic.

As to the vexed question of anisometropia, the results are balanced, and negative in their showing. The relation of *conus* to the refraction is not very definite—so far as it goes, apparently in conflict with the accepted views. It was noted in 25 = 79. % of the Em. eyes, in 11 = 78.5 % of the M., in 5 = 100. % of the M. As., in 35 = 53.8 % of the H., and in 40 = 62.5 % of the H. As. As with the question of the apparent emmetropia, full confidence cannot be asked for results in this matter not obtained under full action of a mydriatic.

Four previous studies of the refraction in medical students are on record: Cohn, Breslau, 1867; Cohn, Breslau, 1881; Collard, Utrecht, 1881, and Van Anrooy, Leyden, 1884. Of the two examinations of Cohn full details are lacking, and only the following data can be given:—

Age.	Indiv.	Eyes.	Em. A.	M. A.	-0.25 - 1.	1.25 - 2.	-2.25 - 3.	-3.5 - 4.	-4.5 - 5.	-5.5 - 6.	> -6.	H. m.
17-36	71	...	26 = 37.	40 = 56	...	...	...	...	...	...	...	5 = 7.1
...	108	216	81 = 37.5	116 = 54.	25	22	12	18	18	11	8	10 = 8.8

In each of the Hollandish investigations, the individual results are given in full, and the following data are obtainable. Collard, among the 550 students in the University of Utrecht, examined 410—testing 120 of the total 136 medical matriculates. His results were:—

AGE.	EYES.	Em. 4.	.25	.5	.65	.75	1.	1.25	1.5	1.75	2.	2.25	2.5	2.75	3.	6.5	H.m. 4.	Av. H.m.
18-20	94	42	44.7	...	5	...	6	2	...	4	1	...	1	...	1	1	21 = 22.3	1.31
21-22	46	17	37.	...	...	...	1	5	2	...	...	...	1	1	...	...	10 = 21.7	1.35
23-24	38	20	52.6	...	...	...	1	2	...	...	...	...	...	...	...	...	3 = 8.	0.92
> 24	62	34	54.8	...	3	...	4	2	1	1	2	...	...	1	...	...	15 = 24.2	1.20
TOTAL.	240	113	47.1	...	8	...	12	11	3	5	3	...	1	2	1	1	49 = 20.4	1.25
—.25 —.5 —.75 —1 —1.25 —1.5 —1.75 —2. —2.25 —2.5 —2.75 —3. —3.5 —3.75 —4. —4.5 —5. >5.																		
...	15	3	1	1	2	1	...	1	1	...	1	...	1	2	...	...	2 31 = 33.	1.52
...	2	1	1	1	3	2	...	...	1	...	...	...	1	2	...	...	5 19 = 41.3	1.93
...	1	4	...	...	...	...	...	...	...	...	2	1	2	1	3	1	15 = 39.9	3.18
...	...	4	5	...	2	...	...	...	...	...	...	...	...	...	...	...	2 13 = 21.	4.21
...	18	12	7	2	7	3	...	1	2	...	1	2	3	6	1	3	10 78 = 32.5	2.39

Of 740 matriculates, in the various departments of the University of Leyden, 470 were examined by Van Amrooy, 213 of them being medical. Among these he found:—

AGE.	EYES.	Em.	+2E	.5	.75	1.	1.25	1.5	+1.75	2.	2.5	3.	3.5	4.	4.5	5.	H.m.	Av. H.m.
17-20	150	83 = 55.3	...	...	...	16	2	4	...	...	...	...	...	...	...	...	22 = 14.6	1.11
21-22	118	70 = 59.9	...	...	...	2	4	...	1	1	2	1	2	...	2	2	19 = 16.1	2.59
23-24	86	48 = 55.8	...	...	...	5	11	...	...	...	1	2	2	...	1	1	23 = 26.7	1.74
> 24	70	43 = 61.4	1	...	...	...	4	...	...	...	...	...	...	...	...	...	5 = 7.1	0.85
Total.	424	244 = 57.5	1	...	...	7	35	2	5	1	2	2	4	2	2	3	69 = 13.9	1.69
$-2.5 \quad -.5 \quad -.75 \quad -1. \quad -1.25 \quad -1.5 \quad -1.75 \quad -2. \quad -2.5 \quad -3. \quad -3.5 \quad -4. \quad -4.5 \quad -5. \quad -5.5 \quad -6. \quad > 6.$																		
...	4	3	9	...	6	...	...	5	2	1	6	3	2	...	2	2	45 = 30.	2.66
...	4	1	...	...	5	...	...	...	3	3	5	...	...	2	...	6	29 = 24.6	2.95
...	2	...	5	...	1	...	3	1	...	1	1	...	...	...	1	...	15 = 17.4	1.97
...	3	...	3	1	2	...	4	1	1	...	2	...	1	2	...	2	22 = 31.4	2.71
...	10	4	17	1	14	...	7	7	6	5	14	3	2	4	2	10	111 = 26.2	1.91

Similarly stated, the results of the investigation in Philadelphia are for the manifest refraction:—

AGE.	EYES.	Em. %	+5	+0.5	+0.75	+1.	+1.25	+1.5	+1.75	+2.	H.m. $\phi$ .	Av. H.m.
19-20	34	11 = 32.4	7	2	3	...	...	...	...	...	12 = 35.3	0.59
21-22	30	13 = 43.3	3	1	3	...	...	...	...	...	7 = 23.3	0.63
23-24	44	21 = 47.7	7	3	...	...	...	...	...	...	10 = 22.7	0.54
> 24	34	6 = 17.6	6	2	...	...	...	...	...	...	8 = 23.5	0.54
TOTAL,	142	51 = 35.9	23	8	6	...	...	...	...	...	37 = 26. +	0.57

	M. $\phi$ .	-2.5	-1.5	-0.65	-0.75	-0.9	-1.	-1.25	-1.5	-1.75	-2.	-2.75	-3.	-4.5	-5.	Av. M.
	11 = 30.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.69
	10 = 33.3	1	1	...	...	...	...	...	...	...	...	...	...	...	...	1.39
	13 = 29.6	...	...	1	1	1	1	1	...	2	1	...	...	...	...	1.67
	20 = 59.	...	...	5	1	1	...	...	...	...	...	...	...	...	...	0.61
	54 = 38.	2	28	1	8	2	3	1	1	1	1	2	1	1	2	1.03

The contrast in the greater frequency and higher grade of the myopia among the Breslau students is very apparent; but close comparison is impossible. The results in the Universities of Utrecht and Leyden are strictly comparable to those in the University of Pennsylvania in almost every point; the smaller number in

the latter case, and the fact that they constituted about one-half of the second year class alone, instead of fully representing the entire school, being the only notable differences. As to the determination of the manifest refraction in the Philadelphia study, while the writer freely concedes that he laid less stress upon it as a means to accurate results as to the true refraction of the eyes tested, and not infrequently omitted it, he can none the less justly claim that the test, when applied, was employed with the utmost care. In age, the students quite nearly correspond in all the studies. In Germany, all students must have passed through the Gymnasium before entering the University, and the same probably holds good for Holland. Such is, of course, not the case here; but, as will be seen, at least 30 per cent. of the medical matriculates of the University of Pennsylvania have already received a Bachelor's degree in arts, science or philosophy; while many others have passed through elective collegiate courses and obtained proficiency grades not recorded. For the remainder, the entrance examination, though not stringent, presupposes a fair academic education; so that the educational standard is in a considerable proportion higher, and, on the average, certainly no lower, than in the European schools.

It is probable that among larger numbers of American students higher grades of ametropia would have been occasionally found; yet in the present study it is notable that by the glass-test there were found no cases of hypermetropia higher than  $+0.75$  D., nor of myopia above  $-5$  D.; only ten eyes being above  $-1$  D. The ophthalmoscope and other methods show the existence of higher grades of H., but none above  $+2$  D.; while among the myopes the low grades only of myopia seem to have been simulated or increased by spasm. The proportion of apparent emmetropes agrees closely with Cohn's results; but the other tests show that real emmetropes were not more than half as frequent, in spite of every eye being called emmetropic which was not definitely proven otherwise.

That controlling tests with the ophthalmoscope and other methods would have had a similar effect upon the statistics of the foreign observers in decreasing the array of myopes and increasing the proportion and grade of hypermetropia cannot be absolutely asserted; yet large numbers of more or less comparable cases give great confirmation to such an assumption. Thus, Conrad, in the

Gymnasium of Königsberg, found among 3036 eyes, Em. 55 per cent., M. 33 per cent., and H.m. 11.7 per cent. by the glass-test; and by the ophthalmoscope, Em. 30 per cent., M. 22.3 per cent., and H. 47.5 per cent.—the results among the oldest pupils corresponding well with those for the whole school. In like manner, Dürr found in the II. Lyceum of Hanover, among 318 pupils, Em. 28.3 per cent., M. 38. per cent., and H.m. 33.6 per cent. (?) by the glasses, and after Homatropine, Em. 7.8 per cent., M. 31.7 per cent., and H. 60.4 per cent. Among the older pupils in a seminary the results similarly obtained were: Em. 29.5, M. 33.3, and H.m. 37.5 per cent., as against Em. 9.4 per cent., M. 33.3 per cent., and H. 57.3 per cent., after the mydriatic.

Before presuming to draw, in closing, any conclusions from such a limited study, a few remarks seem called for. The foregoing data are offered as a small contribution to a large series of investigations, all more or less imperfect, with the hope that they may form a beginning which can be amplified and improved later. Imperfect as they are in many respects, they will compare only too well with most similar work on record. The general questions involved in these investigations are elsewhere discussed; suffice it to say here, that of about 125 investigations, of which the records are before the writer, only 20 seem at all comparable in the methods employed to secure approximate accuracy, and many of these are studies of the eyes of infants. The introduction of elaborate detail in extended investigations may be practically impossible; if so, it is time to let such sweeping statistics alone, and limit the examinations to numbers commensurate with the fullest care and completeness of detail. Studies without a mydriatic are confessedly imperfect; but, practically, a mydriatic can be very rarely employed, and a critical comparison of the results of the various methods in the same cases will do much to show their relative accuracy and whether average corrections may be used with advantage. The practical hygienic possibilities of such examinations are enormous, as is being more and more clearly recognized in Germany, where the evil is most pressing; and they will be eventually recognized everywhere. Yet scientific accuracy is the first requisite to their obtaining any respect for their findings and teachings, for then only will they cease "to vary like the wind," as an eminent student of the subject has put it. A plea for more careful work in the future seems most distinctly in place, and is not wholly negatived by the imperfections of the work here

set forth. It should be remembered that the prime object here was the instruction of the students of the class, and that the data set forth are such as the writer could incidentally obtain. Less than ten hours were devoted to the examination of upward of one hundred individuals and the explanations called for by it; and in the absence of special assistance, the records are often incomplete. Yet, for the accuracy of the record in almost every point given, the writer can vouch.

In conclusion, the following points may be cited as noteworthy:—

Of the 90 students,  $8 = 9$ . per cent. appeared emmetropic; all the rest being ametropic, generally in low degree, in one or both eyes. Of 180 eyes,  $32 = 18.8$  per cent. were set down as emmetropic; although several of these had normal vision only with a concave glass, and defective vision, functional discomfort, and intraocular disturbance were but little less frequent among them than among the ametropic eyes.\* Myopia of one or both meridians was met in 11 individuals, in 5 of whom it was monocular. In no case was the condition of the fundus fairly good, all presenting disturbance of the choroid demanding medical care. Astigmatism was found in the five myopic eyes measured under a mydriatic, and was probably present in most of the others. Hypermetropia was the preponderating condition of refraction, constituting 71.6 per cent. of all the eyes studied; although but 26 per cent. manifested their hypermetropia by the glass-test. At least one-half of these presented a notable degree of astigmatism, while many more were doubtless really astigmatic.

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\* Partially explained by insufficiency or by ametropia of the other eye.